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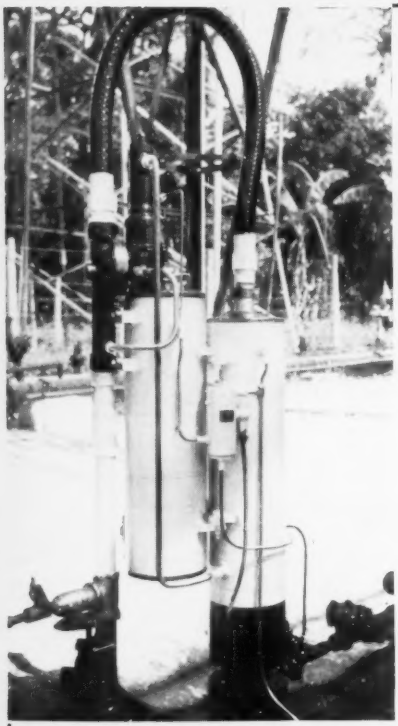

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Editor: George Sell

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THE LONG RANGE PICTURE*

By HOWARD PAGE†

The oil industry is dynamic and progressive. Change is normal; the *status quo* abnormal. The industry has been constantly adjusting itself to meet the ever-changing needs of people around the world. It has done more. It has developed new products and new uses for products even before consumers realized their need for them. Furthermore, competition within the industry has brought about remarkable scientific developments and efficiencies in all branches of its operations. Where competition has been the keenest, the advances have been the greatest.

In looking to the future there is every reason to believe that this progressive evolution will continue. But the rapidity of future progress in meeting people's needs will depend on the degree of competition and freedom from artificial controls—if the past is any criterion.

Before discussing the future, the questions "Why do we try to predict the future?" and "What can we reasonably expect from such speculations?" might usefully be answered.

The principal reason for a careful projection into the future is to provide a direction in which to work and move in the immediate days ahead. Thereby each individual and oil company can have a yardstick with which to measure

* From an address given before the London Branch of the Institute, April 20, 1950.

† Anglo-American Oil Co. Ltd.

the desirability and consistency of its various actions. The alternative would be expediency and actions inconsistent with each other.

It is only human to want to know exactly what will happen during the next 5, 10 or 20 years ahead. There is great danger in assuming that a competent forecaster can do this. It is not possible; the best to be expected is a prediction of general trends and an analysis of the influence of one changing factor on another.

How far ahead is it profitable to forecast? In general it may be said that any forecast which is not necessary as a basis for present action is idle speculation.

Long before the war ended there were many predictions, including those of the author that the Middle East oilfields and European refineries would be developed rapidly after the war ended.

A prediction of this nature was relatively easy. All of the economic forces pointed in one direction. It would have required a catastrophic change in world affairs to have prevented this.

The accurate prediction of oil consumption in a particular year or season is much more difficult. There are innumerable unpredictable factors—weather, for example—which can throw out the most careful analysis. So the limitations of forecasts as well as their uses must be recognized.

There is no reason to change the predictions made several years ago that the eastern hemisphere will become self-sufficient in oil. That realization of this is already in sight is evident from announced plans for production, transportation, and refining and the only part not yet completely planned is the full production of speciality products. It is safe to predict that within two years specific plans to accomplish this within the following two or three years will be settled. The pressure to do so is one of balance of trade.

However, speciality plants require large capital expenditures and can be economic only if they are of sufficient size. Increased consumption will bring this business into the economic range and capital may become more freely available after the larger and more pressing projects are completed and earning profits. Aviation gasoline and lubricating oils are the principal items in this category.

Two years from now it seems reasonable to expect a net volume movement from the eastern hemisphere to the west. Five years from now there will probably be a net movement westward in value as well as volume of petroleum.

Bunker Trade

Another major shift which seems reasonable to predict is the world-wide bunker trade. At present a large proportion of the trans-oceanic bunkering takes place in western hemisphere ports. The reason is simple. The price is lower by approximately the cost of the tanker haul from west to east. However, when eastern hemisphere refineries now building come into full operation, residual fuel oil will be pushing for new outlets. Hauling this fuel oil to the western hemisphere would not be very profitable. It would be much easier and less costly to attract the bunker trade to this side. When adequate supplies are available in the eastern hemisphere to eliminate the need for hauling western hemisphere fuel to this side it seems reasonable to expect prices to reflect the situation. As eastern hemisphere fuel becomes more competitive in the bunker trade it will also become more competitive with other fuels in the inland trades. Thus the traditional balancing of supply and demand through price—if allowed to operate freely—will bring about substantial changes in both bunkering points and in inland use.

The Middle East

From a crude oil supply standpoint everything indicates to further sub-

stantial developments in the Middle East. During the next three years it is expected that the largest increases will come from Iraq.

The production from Iraq has not increased as rapidly post-war as in other countries because the proven reserves were far inland and sufficient large-diameter pipe has not been available to move the oil to seaboard. As a result, other Middle East areas expanded first to meet the huge post-war demands. Now that pipe is becoming available, Iraq crude supplies will increase rapidly to supply a high proportion of the new eastern hemisphere refineries under construction.

There seems to be no question of adequate crude supplies being available, and in time, to meet all of the foreseeable needs of the refineries under construction and planned.

Once this large refining programme is completed—in about three years—the further increases in requirements for Middle East crude will be less rapid. They will depend upon increased consumption in the eastern hemisphere and no longer upon replacement of supplies moving in from other areas. This points to a levelling off in Middle East activities which is already evident in all producing countries except Iraq.

Transport

Supply and transportation are closely interwoven. It may be asked whether pipelines will supplant tankers in hauls from the Persian Gulf to the Mediterranean in the future. It looked that way several years ago. However, the development of larger and more economical tankers, and the difficulties encountered in building and operating pipelines through several countries have changed the picture to some extent. In addition, devaluation of the pound sterling has had an important effect on the relative economics. Large-diameter pipe is available only for dollars, while large tankers can be built in the United Kingdom. There are also many intangibles involved—the relative value of mobile rather than immobile assets, for example. The outcome is not predictable at this time. However, when more pipelines are built a continuation of the trend toward larger diameters and fewer pump stations is likely. Pipe fabrication in the field looks like a future possibility on big lines in remote areas. This would save shipping and handling costs and help the trend mentioned above. On the other hand, there is no reason to believe that tankers have reached the limit of efficiency; so the competition between these two methods will continue to be keen.

The Western Hemisphere

In looking at the future supply picture in the western hemisphere there are several trends which may well continue.

(1) *In the United States more and more refining equipment will be installed to obtain higher yields of the more valuable products. This seems inevitable because the sharp competition from natural gas, and to a lesser extent from coal, limits the market value of residual fuel oil to a price considerably below crude oil cost to the refiner.*

(2) *Canadian crude oil production will move to the Great Lakes area and eventually to the west coast.*

(3) *Oil exports from the United States will be limited to tributary markets, exchanges and specialty products in decreasing amounts. Economic forces make this inevitable. At present these exports, including foreign trade ships bunkers, are about 6 per cent of the total demand. Within a few years they will probably not exceed 2 per cent.*

(4) *Petroleum output can keep pace with demands in the western hemisphere for many years to come.*

During the past three years in the United States 1.7 tons of petroleum have been added to proven reserves for every ton produced. During these three years the amount of oil proved up in the United States was equivalent to about 80 years of present U.K. consumption, or 35 years for the sterling area as a whole.

This rate of finding, even taking into account the effort expended, is a good indication of much larger undiscovered reserves remaining than most people have guessed. It has a significance for synthetics. The economic justification for synthesis of coal and shale into liquid fuels seems farther away than ever. No doubt experimentation will continue and some synthetic plants in special locations and for special uses will appear. But a large-scale synthetic industry is far enough away so that guessing the date of its appearance would be pure speculation.

The Future

For many years most, but certainly not all, of the developments in production, pipelines, refining, and marketing originated in the United States. It is only natural that this would occur because most of the oil activities took place in the U.S. It may be predicted however, that the balance will change in future years. The oil problems of Europe and the eastern hemisphere are not identical with those of the west. The rapid developments in Europe will bring with them new problems. The solution to those problems will be worked out mostly on this side. Both techniques and technology will develop rapidly in Europe—so long as the economic pressures of competition are present.

In refining there are problems of economic sulphur removal—more pressing in Europe than elsewhere because of the high sulphur content of Middle East crudes. There is the yet unsolved problem of economically improving the octane of the lighter gasoline fractions. Economic refineries for the small markets—producing suitable products—are yet to be developed. The whole field of petrochemicals is wide open.

In distribution and marketing there is plenty of room for both increased efficiency and consumer satisfaction. Each market and each product has its own peculiarities; so in the end the solutions to problems must be worked out locally. However an increased application of scientific analysis and methods should and will bring about economies in this field of greater magnitude than result from the same amount of effort in refining, for example.

To summarize: the rapid progress of the oil industry will continue if unhampered by controls. Many developments can be expected in practically all branches of the industry. Proportionately the growth and changes in the eastern hemisphere will, during the next few years, be even greater than in the west. The source of technological progress may also be expected to shift somewhat from west to east. Higher living standards for the people of the world involve higher oil requirements. The oil industry can and will meet these needs as they have in the past. For those who like change and progress, the oil industry still provides a very interesting future.

★ ★ ★

STUDY OF CLAYS

An International Committee for the Study of Clays (C.I.P.E.A., Comité International pour l'Etude des Argiles) has been formed with the aim of grouping specialists in this field from different countries. British representatives are Dr D. M. C. MacEwan (Rothamsted Experimental Station) and Dr G. W. Brindley (University of Leeds), who invite communications from those concerned with the scientific study of clays.

PIPELINES*

By J. P. A. DE WAELE (Assoc. Member)†

Every motorist is familar with the small sight-glass fitted to roadside petrol pumps which, in addition to its original purpose, now enables him to verify the colour of the spirit he is buying. It is more than likely, however, that he does not realize what a singular episode in the life history of the petrol is its passage through this glass. Usually, this brief moment is the only occasion on which this particular petroleum product sees the light of day throughout its long life, including the millions of years during which the crude oil was formed, the few months during which it was transported and refined, and the all-too-short period in which the petrol was consumed.

To take a typical case: crude oil gathered at the well-head and taken through gathering lines to the stabilizing plant is then pumped through pipelines to tankage at the refinery, whence it is taken through the refining plant, and the various products stored in tanks, shipped, stored again, and distributed. During the whole of this time the great bulk of the crude and of its products, apart perhaps from samples, has spent its life in tanks, pipes, pumps, processing plant, and tankers.

Historical

The use of open channels for conveying water is of immeasurable antiquity and closed pipes date back at least 7,000 years, if not more. For a long time pipes were difficult to make, for the choice of materials was limited and the fabrication laborious. They were made, for example, of sewn hides, earthenware, lead, hollowed wood, stone, etc., and were soon found to have great advantages over open channels. Possibly the first advantages realized were reduction of evaporation losses and contamination, but these are less significant than the discovery that, within limits, pipes, unlike channels, do not have to be laid level and if they collect water from a high point, can pass over smaller hills on their way to the user. From the 16th century onwards, when pumping engines were developed, increasing use was made of pipes, so that by the 19th century pumped water pipelines were common practice.

It was therefore quite natural that from the very beginnings of the petroleum industry advantage was taken of pipelines to transport oil across country often very difficult for vehicles to negotiate. The first oil line was probably a 4 inch diameter wooden pipe, 6 miles long, laid in Pennsylvania in 1861. Four years later, a 2-in cast iron line, also 6 miles long, and equipped with steam-driven pumps, was laid in the same oilfield. Progress was steady from this time onwards, and by 1900 some 18,000 miles of pipe, chiefly of cast iron, were in use in the U.S.A. Subsequent figures for the U.S.A. give some idea of the even greater development once the automobile industry had increased the demand for oil production.

1920	64,000 miles
1940	126,000 miles
1950	(estimated) 170,000 miles

In the one year, 1949, total completions in the U.S.A. were assessed at 15,000 miles, or nearly as much as in the 39 years from 1861 to 1900. In recent years an increasingly high proportion of new construction has been for natural gas lines. In other countries the figures are of course smaller, but show the same trend. At present,

* An address to the London Branch of the Institute, December 29, 1949.

† Anglo-Iranian Oil Co. Ltd.

projects in course of construction are estimated to amount to 35,000 miles for the whole world. Moreover, the size of lines has been steadily increasing, so that even these figures do not give the whole picture of the very large tonnage of material involved, or the immeausurably greater increase in the total volume of fluids handled.

Economics of Transportation

Before studying advances in technique which have facilitated this great expansion in both the length and the size of lines, it is worth examining the economics of transportation by pipeline. Natural gas in commercial quantities can only be moved by pipe, so that in this case the economics of tapping the supply, conveying the gas by trunk line to the users' centre, and distribution to individual users, is easily analysed without reference to any alternative. In the case of oil, however, whereas in the early days lines were used merely to reach the nearest railhead or port, they now stretch across a continent and may provide a continuous link from well to distribution centre. The pipeline can therefore be regarded as an alternative to batch transport by rail tank car, or road tank wagon.

What are the factors affecting the choice of method? In general, the cost of batch transport between any two points does not vary materially with the quantity transported, as it only means choosing the right number of container vehicles. On the other hand, the cost of pipeline transport per unit conveyed falls rapidly with the quantity, as for any increase in pipe size the capacity of the line increases proportionately more than the cost of laying and operation.

The capital cost of the pipeline is high compared with all systems of batch transport, but the operating costs are relatively low and, apart from that of fuel for running the pumps, are largely made up of fixed charges such as labour, maintenance, etc. Consequently, the lowest operating costs per ton of oil can only be achieved if the line operates constantly at full capacity. Moreover, once the line is laid it is not possible to change its destination, nor is it easy to alter its capacity. A pipeline system is therefore inflexible compared with batch transportation. When, however, it is possible to be sure about the required capacity and destination, the pipeline becomes a practical proposition and, depending to a certain extent on local conditions, when the capacity exceeds one million tons per year the pipeline shows a net saving in cost per ton/mile over rail or road transport, this saving increasing rapidly with capacity. This means that, for long distances, lines of 8 inches and over will compete with batch transport.

Pipelines versus Tankers

Sometimes, because of geographical features, an overland pipeline would appear to be an advantageous alternative to sea transport. A good example is the over 1,000 miles of desert separating the oilfields at the head of the Persian Gulf from the Mediterranean, the corresponding distance by sea being of the order of 3,500 miles. Until recent years, despite this big difference in total distance, and the canal dues operating against tankers, the overland method would not have paid and the only long trans-desert pipelines in this area were laid by the Iraq Petroleum Company as an outlet for the Kirkuk field, which is much farther from the Gulf than the others and only 600 miles from the Mediterranean. But this picture has changed, since during the last war, two very large lines were laid in the U.S.A. for transporting crude oil and products respectively from Texas to the New York area. These lines, a 24-inch diameter pipe known as the "Big Inch," and a 20-inch diameter pipe known as the "Little Big Inch," were put in as a war emergency measure, and not from any motives of economy, at a time when

tankers were short and when tanker losses along the Atlantic seaboard were alarmingly high.

On taking stock after the war, however, it was found that the cost per ton in the 24 inch line was appreciably less than that in the 20 inch line, as might be expected, and that the former figure was beginning to approach the cost of transport by coastwise tanker, although the distances were comparable. As manufacturing facilities had by then been developed to the point that even larger pipe could be made on a big scale, the possibility of economic operation of lines across the Middle East desert was examined afresh, investigation being stimulated by the rapid development of the oilfields in that area. Results showed that pipes of 30-inch diameter and upwards would show a substantial saving relative to transport by tanker, any increase upon this strengthening this advantage. Moreover, although the total steel tonnage involved was of the same order, for the line or for a tanker fleet, the former was in less highly fabricated form. It should be added that the comparison was made with the tankers current at the time, and not with 28,000-ton vessels. This discovery led to the formation of the Trans-Arabian Pipeline Company, who are now constructing a 30 to 31-inch line from Abqaiq to Sidon, a distance of about 1,000 miles. Other projects include that of Middle East Pipelines Company, who propose laying a 34 to 36-inch line to take Iranian and Kuwait crude to the Mediterranean.

Thus it will be seen from this brief outline that the continual trend has been for bigger pipe and more of it. This has automatically introduced other demands, notably for bigger pumping equipment, for better pipe material to permit the use of thinner-walled pipe and thereby save steel, and for better field construction technique to enable these projects to be speeded up.

Developments in Design

The main developments which have permitted these improvements in design may be summarized as follows. The materials used for a very long time were cast iron and wrought iron, and pipes were nearly all supplied with threaded ends for making joints in the field by means of screwed collars. About 1910, steel began to be used. At first pipes were made from plate rolled to shape and lap-welded; the longitudinal seam of this sort of pipe is a great source of weakness. Then, seamless pipe was introduced. This is made by piercing a billet and subsequently subjecting it to a series of rolling operations around a mandrel which elongate it, thin down the walls, and generally true its shape. Both these types of pipe were still supplied with screwed ends. By 1927, lap-welding began to be replaced by the much sounder electrical butt-welding of the longitudinal seam and about this time the gas-welding of pipe joints in the field was introduced. Because of the undesirable spatter which gas-welding causes inside the pipe, it was found desirable to swell the ends of each pipe-length and provide an internal sleeve which was placed at the joint to maintain a smooth inner surface. The I.P.C. 12-inch line already mentioned was the first electrically welded line to be laid outside the U.S.A. This had sleeve-welded joints. Electrical welding of the field joints was soon developed to give more reliable results than gas-welding, and had the great additional advantage of allowing a much cheaper plain butt-welded joint to be used.

Since these landmarks, development has been less obvious, consisting of improving the technique of welding, both in the factory and in the field, improving the properties of the material, and increasing the size of pipes which can be made. At the present time, for example, in the U.S.A., seamless pipe can be obtained up to 26-inch diameter, and electrically welded pipe up to 36

inch diameter. In the last few years a practice used to an increasing extent in manufacturing electrically welded pipe is to subject the completed pipe to a very high hydraulic pressure whilst it is contained in a rigid die of slightly larger diameter. The purpose of this is threefold. First, it straightens and makes the pipe truly circular and ensures standard finished dimensions; secondly, it proves the weld; and thirdly, it increases the yield point of the material. The advantages of the last-mentioned point are not universally agreed, as the increase in strength is obtained at the expense of a loss in ductility, and it is always possible for the subsequent welding of field joints to reduce the mechanical properties to their original values before cold-working.

Pump Design

Parallel with these great changes to the pipe itself, there has been considerable evolution in pump design, and pumps must be regarded as an integral part of any modern pipeline system. For a very long time pumps were invariably of reciprocating type operated by steam. Even after internal combustion engines became widely used for other purposes, steam was still used as motive power, as boilers were always required in the oil producing areas for other purposes. Moreover, the internal combustion engine introduced a fire hazard. During the 1914-18 war, the Anglo-Iranian Oil Company ordered the first steam-driven centrifugal crude oil pumping sets, for its pumping station at Tembi, in Iran. The use of centrifugal pumps was taken up in the U.S.A. around 1922, and is now very widespread, particularly for large lines. Later, the A.I.O.C. converted similar steam-driven sets to operate on natural gas, using the expansive energy of the latter only.

Since then the variety of design, dictated by special requirements and local conditions, has become enormous. Gas engines, petrol engines, diesel engines, diesel engines operating on crude oil taken from the lines they are boosting, and electric motors are all used. Reciprocating pumps of direct-acting and of crankshaft type, centrifugal pumps with multiple stages used singly or in parallel, and single-stage centrifugal pumps used singly or in series, are all used. There is not sufficient space to give more than a few of the main reasons affecting the choice of pumps and prime movers. Reciprocating pumps are slow moving and are therefore more suitable for use with large internal combustion engines or reciprocating steam engines. Centrifugal pumps, on the other hand, rotate fast and are therefore well suited to electric motors, turbines, or small I.C. engines geared together, such as the General Motors' "Quad." Where the power is available, electric motors are very attractive because of their low initial cost and great reliability, but they have the disadvantage, in all but the small sizes, of being constant speed machines. Large internal combustion engines are often used to drive centrifugal pumps in isolated locations. For this, speed increasing gears are needed, but this drawback is offset by the fact that the engines can draw their fuel from the line, and require much less water than steam engines. Another example of expediency is the use of gas engines for operating the compressors on gas lines as the necessary gas is drawn from the line.

With such a large number of variables at the disposal of the designer, including the size of pipe, the type of pump and the distance between the pumping stations, it is hardly surprising that no two lines are alike. Diameter of pipe varies from 6 to 30 inches. Lines may be single or multiple and stations may be as near as 25 miles or as far as 150 miles apart. The capacity of a line of a given length depends upon the diameter, the total difference in pressure

between the ends, and the physical properties of the oil, i.e., density and viscosity which will themselves vary with temperature. The physical properties of the oil are generally beyond the control of the pipeline engineer, except that on occasions the oil may be heated to render it more fluid, so that the variables he is left to select are the line diameter and the operating pressure. As these are independent of one another, it would appear that a large number of solutions are possible. For example, a large pipe operating with a low-pressure drop can in theory have the same capacity as a small pipe operating with a high pressure drop, the former requiring more steel and therefore higher capital expenditure, and the latter more pumping power and therefore higher operating costs. In practice, there is an optimum relationship and the range of combinations adopted is fairly limited. In general, it is found that the various diameters of pipe have the following capacities:—

Diameter	*Cap. in Million Tons per Annum*	
Inches	*Useful Range*	*Normal Optimum*
6	0.3— 0.6	0.5
8	0.7— 1.3	1.0
10	1.4— 2.5	1.7
12	2.3— 4.1	2.75
16	4.4— 8.0	5.90
20	8.0—14.5	11.0
24	12 —18	Not
30	18 —28	yet
36	30 —45	estimated.

The quality of pipe available will determine the maximum permitted working stress and this will allow the permissible pressure for various thicknesses of pipe to be determined. The required capacity will determine the necessary pressure drop or hydraulic gradient which is, in effect, the energy absorbed in overcoming fluid friction expressed as a loss of pressure per mile. Taking into account differences in ground level, the station spacing can then be calculated from the operating pressure and the hydraulic gradient. Increasing the wall thickness will enable the stations to be spaced farther apart, as it allows a higher working pressure, but it involves a greater amount of steel. At this point, as in most engineering problems, a compromise must be struck, comparing the steel tonnage against station equipment and operating costs.

Once the broad principles of the line are decided, further refinements can be introduced to reduce costs. One consists of "tailoring" the line, which means reducing the wall thickness in increments at sections of the line where the pressure has dropped sufficiently. The second consists of making a line of approximately equal lengths of pipes, of slightly different diameters, the smaller of which can be nested inside the larger, thus reducing shipping costs considerably. This is a particularly attractive proposition for pipelines in the Middle East, where the pipe must always come by sea, and two notable examples are the Tapline of 30-31 inches and Anglo-Iranian Oil Company's new 20 to 22-inch line between Agha Jari and Mashur.

Construction Technique

Aspects of pipelines which can be regarded as design office and cost department problems, have so far been considered in this paper, but little attention has been given to actual construction. The technique of construction has perhaps made more spectacular strides than anything else. The first lines were taken to site by horse transport, laboriously joined by tightening screwed joints with tongs, lowered into a hand-dug ditch and, if made of steel and not of cast iron, probably replaced a few years later because they were badly corroded. Various proprietary products were developed to combat this corrosion, more or less successfully. In 1918, after repeated and somewhat unsuccessful attempts to overcome this ground corrosion, the Anglo-Iranian Oil Company

decided as an experiment to lay some of its pipelines in Iran upon the surface, supported on bearers just high enough to keep the pipe off the salty ground. Because of the very big temperature range obtaining in Persia, it was necessary to provide for expansion, and this was done by laying a line in staggered formation of 200-foot straight lengths, connected by a bend which gave alternative offsets of 6 ft on either side of the centre line. This experiment proved so successful that nearly all the company's subsequent lines were laid in the same manner, and most of the existing buried lines were lifted. It is only fair to add that this very simple method of overcoming corrosion trouble is usually not open to operators in the United States, who have to consider agricultural requirements as well as to observe regulations in built-up areas, and elsewhere are faced with innumerable road and rail crossings.

It was hoped that this simple solution could always be used in the Middle East. However, the new, very much larger lines which have appeared in the last few years are comparatively less robust. The wall thickness has not increased, but sometimes has even been reduced, in proportion to the diameter, and because of their greater weight the pipes do not slide easily on the supports, so that they must either be buried or, if run on the surface, laid in straight lines with, at frequent intervals, adequate restraint to maintain their straightness and cope with stresses caused by temperature change.

From the end of the first world war until the present day, very great advances have been made in the mechanization of pipeline construction. Special vehicles have been developed for transporting the pipe, for handling it, bending it, for cutting the ditch, cleaning the pipe, priming it, wrapping it, testing the coating, and back-filling the completed ditch. Great strides have also been made in the coating materials, both liquid and the wrapping material, and as an additional precaution, cathodic protection has been introduced. This mechanization has enabled, in the last few years, construction speeds of one to two miles per day on very large pipe, 24, 26 or 30-inch for example, to be maintained, so that some of the recent projects, sometimes 1,000 miles long, with up to 20 pumping stations aggregating 100,000 or 200,000 h.p., have been completed in two or three years.

Notable examples of the present-day trend in pipelines are the Tapline, the Big and Little Inch lines, to which reference was previously made, the Texas-California gas line, 1212 miles of 24, 26 and 30-inches, designed to carry 305 million cubic feet of gas per day, and using total compressor power of 130,000 h.p. A similar gas line involving 1839 miles of 20, 26 and 30-inch pipe and costing 200 million dollars is now planned to convey 500 million cubic feet per day of natural gas from Texas to New York.

Temporary Pipelines

Certain special problems have been overcome in recent years, one of the most important being the temporary pipelines laid during the war to maintain the supplies to a rapidly advancing army, for example, the special lines employed in Operation PLUTO. In this, a series of pipelines was laid from the Isle of Wight to the Cherbourg Peninsula, and later from Dungeness to Boulogne, which during this period of operation, transferred 172 million gallons of petrol from England to France. Two systems were used, both working at the very high pressure of 1,500 p.s.i. The first were lead-lined, steel-wrapped pipes of 2 and 3-inch diameter, similar to a submarine telegraph cable from which the core had been omitted, and which was coiled in the hold of a cable-laying ship and laid according to normal submarine cable technique. The second type was a 3-inch diameter seamless

steel pipe, welded into a continuous length, and wound round a huge drum of more than 30 ft diameter. In the laying of this pipe the drum, which remained buoyant when fully loaded with 70 miles of pipe, was towed by two tugs whilst the pipe slowly unrolled from it and sank to the sea bottom.

In the Far East, the American Army laid a pipeline from Calcutta to Wanting in China, a total length of 1,800 miles through very difficult jungle and mountain. Since the war, technique of underwater construction, which ten years ago was confined to small river crossings, has now been so well developed that large lines are laid across quite wide sea channels, provided that the water is comparatively shallow and the bottom fairly even. Recently, for example, the Creole Petroleum Corporation has laid 14½ miles of 26-inch line across the Gulf of Coro, in Venezuela.

Construction technique has now reached the point where lines can be laid in almost any part of the world, no matter what obstacles the country appears to offer—extremes of cold and heat, waterless desert, thick jungle or marsh, mountains, rivers and even bays.

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"ROYAL DUTCH" DIAMOND JUBILEE

The 60th birthday of the Royal Dutch Petroleum Co. was celebrated on June 16 in the Hague. Celebrations were opened by an official dinner, at which Prince Bernhard of the Netherlands, members of the Dutch Government, and colleagues from "Shell" Transport & Trading Co., were guests.

Other events included an exhibition, "Sixty Years in the Royal Dutch," a sports festival held at Te Werve, near The Hague, to which all Shell's European companies were invited to send competitors, and a photographic display, "Holland Through British Eyes."

M.I.R.A. OPEN DAYS

The Motor Industry Research Association held their annual Open Days on June 29 and 30, when visitors were invited to view work in progress.

Two of the laboratories were devoted to research on stresses and strains in vehicles and included the set-up for dynamic measurements on wheels of vehicles; an improved device for speed measurement; and a brake load indicator.

Laboratory C showed a test for high-duty oils for high speed C.I engines, with results in the form of graphs and specimens of pistons removed from engines after a 50-hour test run; the influence of piston rings on engine oil consumption and blowby; and engine exhaust valve behaviour with leaded fuels.

In laboratory D were a number of investigations into fatigue and abrasive wear, a recently-installed machine for testing brake fade, and apparatus (including refrigerator, ultra-violet exposure cabinet, and humidity cabinet) for the study of weathering in car body finishes.

A popular exhibit was a portable magnetic recorder now in the experimental stage for recording noise in vehicles. The recorder "played back" the noise made by a light car, a heavy saloon, and a 25 cwt van.

There was too, always a crowd gathered round the screen which showed a continuous performance of a short film of valve motion—showing three examples of ways of inducing rotation of an exhaust valve.

The pleasantly-situated library attracted many visitors, who were invited to inspect the indexing system and examine literature and facilities available. The library exhibited a number of coloured charts explaining its activities, including a swivel diagram showing distribution of demand by members of M.I.R.A. for periodicals etc.

PETROLEUM IN PARLIAMENT

Oil Companies Operations

In a written reply on June 13, the Minister of Fuel and Power said that in the forecast of dollar expenditure in 1950 prepared last December, it was estimated that the British controlled oil companies would spend 535 million dollars in 1950 and would receive for their sales of oil outside the sterling area foreign currencies worth £330 million.

Oil from Coal

The Lord President of the Council said (June 15) in a written reply: that there was a regular exchange of information with the U.S.A. on the distillation of oil from coal.

The production of oil from coal, by carbonization and by synthesis, had been studied in the U.K. for a considerable period by the Fuel Research Station of the D.S.I.R. and by industry. The results of the Department's work had been published. The work at the Fuel Research Station on synthesis was at present being enlarged.

Branded Petrol

The use of brand names, and the sale of a higher quality motor spirit, will be permitted when this can be done without reducing the total supply, said the Minister of Fuel and Power in a written answer on June 19.

Petrol Economizers

Answering a written question (June 20) the Minister of Fuel and Power said his Department had no facilities for experimenting with petrol economizers. Devices of this type submitted to his Ministry, have been referred to the Ministry of Supply, who are responsible for the design and development of vehicles required by the Services and by other Government departments. He had not heard that any such device had been notably successful.

Southampton Water Refinery

Asked what negotiations he had entered into regarding the establishment of an oil refinery or storage plant by the Caltex Co. on Southampton Water in the Hook or Fareham areas, the Minister of Fuel and Power said (June 20) in a written answer that a proposal had been submitted for the erection of an oil refinery somewhere between Portsmouth and Southampton and had been approved in principle by His Majesty's Government; but the precise locality was still under consideration.

The question of the new Caltex Refinery was again raised on June 26 when the Minister of Fuel and Power was asked what alternative sites were being considered between Portsmouth and Southampton, and to what extent had local inhabitants and the Defence Ministry been consulted. In a written reply Mr Noel Baker said that several alternative sites on, and to the west of, Bromwich Farm, Titchfield, were under consideration. All the Departments concerned in the matter were being consulted; and the Ministry of Town and Country Planning had consulted the local planning authority.

Yet another question was asked on this subject on July 3, when the President of the Board of Trade was questioned about the considerations which had led him to approve the establishment of a large new oil refinery approximately opposite to that at Fawley. The Secretary for Overseas Trade said in a written reply that the decision was reached after a thorough investigation of all the circumstances, including the suitability of available sites in other parts of the country and the proximity of markets for the refined product.

CARBON BLACK PRODUCTION

Carbon black production in the U.S.A. during 1949 totalled 1,223,636,000 lb, a decrease of 6 per cent from the 1948 total of 1,297,729,000 lb. Of the 1949 production, 595,986,000 lb was produced by the furnace process using natural gas or liquid hydrocarbons, the remainder being obtained from natural gas by the contact process. The quantity of natural gas used is estimated at 427,892,000,000 cu. ft., the average yield being 2.38 lb/M.cu.ft. (2.41 *lb in* 1948).

Total sales in 1949 (*in thousand lb*) were: 767,131 to rubber companies (870,564 *in* 1948); 32,054 to ink companies (32,436); 7,005 to paint companies (6,799); and 15,976 for miscellaneous purposes (22,634). Average value at plant increased from 5.88 cents/lb in 1948 to 6.10 cents in 1949.

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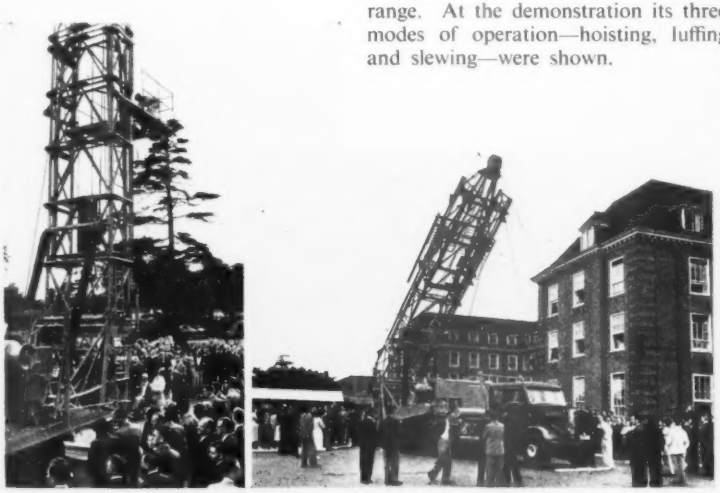
HOIST DEMONSTRATION AT LENSBURY

A 25-ton mobile well-servicing hoist and a 4000-lb truck crane were recently put through their paces at Lensbury, Teddington, for the benefit of 625 members of Shell's export department staff, few of whom would normally have the opportunity of seeing such equipment in action.

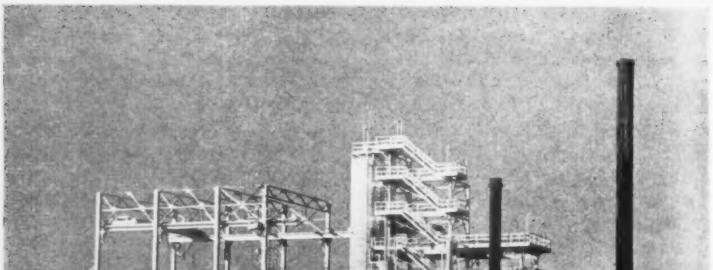
The well-servicing hoist, similar to those which are being exported to Venezuela, Trinidad, India, and Egypt was manufactured by the Woodfield Hoist Co, of Rochester. During the demonstration, the mast was first erected, then a 2-ton load was hoisted on the travelling block with three lines strung to show the control of gears, brakes, etc, and finally the mast was lowered and the unit prepared for transport.

The truck crane, a smaller vehicle, built by the same manufacturers, has a slewing range of 180° and a load-carrying capacity of 4000 lb at all radii between 6 ft minimum and 12 ft maximum in all positions of its slewing range. At the demonstration its three modes of operation—hoisting, luffing and slewing—were shown.



Shell's export department staff watch the demonstration of a 25-ton, truck mounted, well-servicing hoist. On the left, the 64 ft mast is being raised to the vertical position.

THE KUWAIT REFINERY



The construction of the Kuwait Oil Company's 25,000 barrels a day refinery began late in 1948 and was completed in November 1949. The unit produces motor spirit, kerosine, and gas oil to meet the needs of the Shaikhdom of Kuwait and the company's own requirements. In addition, it produces sufficient furnace oil and marine diesel oil to supply bunker fuel to tankers loading crude oil at the company's oil loading pier at Mena al Ahmadi.

The limited quantity of motor spirit required locally is refractionated and stabilized from the main column overhead in a small tail plant. This is followed by plumbite treating and T.E.L. blending to give a 70 O.N. product. Two side streams of kerosine and gas oil are stripped externally. After local requirements are satisfied, these two products are blended with the residue to yield bunker oils, the proportions of each being adjusted to keep the sulphur content and minimum flash figures of the blended products within specification limits.

Owing to the shortage of fresh water at Kuwait, electricity is used in place of steam as the motive power. In addition, the maximum use is made of heat-exchange between the products and reduced crude and the crude oil charge. Cooling water is taken from the sea in a "straight-through" process. To prevent the growth of marine organisms in the cooling system, arrangements are being made for shock chlorine treatment of the cooling water.

The refinery was designed and erected by Messrs E. B. Badger & Sons. Its completion in so short a period in spite of the serious setback which occurred from the loss of materials through shipwreck, is a notable achievement.

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Memorandum, Articles of Association, By-Laws and Regulations. Following the recent changes in the Memorandum and Articles of Association, By-laws and Regulations of the Institute, a new booklet incorporating these changes has been printed, and any member desiring a copy should apply to the General Secretary.

COUNCIL COMMENTARY

Since the last Commentary, Council has held two meetings in May and June —average attendance of twenty. On both occasions the President was unavoidably absent, the chair being taken on one occasion by E. J. Dunstan and on the other by J. S. Parker, both vice-presidents.

In his letter of apology for absence the President asked sanction to call an Ad Hoc committee to meet leaders of the industry, and find out in what further ways the Institute could serve Member-Companies and industry generally. This request was approved.

Council Committee for 1950-1 were appointed and approved, and a casual vacancy on Council was filled by the appointment of Mr O. F. Thompson.

The General Secretary reported that the Annual Dinner for 1951 would be held on March 6, 1951 at Grosvenor House.

After discussion and on the recommendation of the chairman of the Education Committee it was decided to inform the Minister of Labour that, if brought up to date factually, the section dealing with petroleum in their careers pamphlet needed no amendment.

Prof. Garner was appointed to serve on London Regional Advisory Council Committee for Chemical Engineering.

Mr J. S. Parker submitted a cover design and this was approved for the revised Brochure of the Institute.

Reports were received and approved from the Branches, Election, Engineering, Finance, Publications, and Public Relations committees.

From Election Committee there were recommendations for election of 4 Fellows, 8 Members, 21 Associate Fellows, 23 Associate Members, 4 Student Members, 3 Member Companies, a very healthy rate of progress.

The Committee also reported that they were examining procedure closely, in order to minimize delay between application for membership and notification of acceptance.

Branches Committee reported a satisfactory allocation of the bulk financial grant between various Branches and also further efforts to induce all non-corporate members to subscribe to the I.P. Review.

Finance Committee had a cheerful report to make on two points; first that the financial balance was much healthier, and secondly that we had received tax repayment on our re-admission as a charity following amendment of the by-laws. The chairman of the committee suggested that we should give consideration to forming a building fund as soon as practicable.

Engineering Committee reported, through Mr R. B. Southall, having completed a draft safety code dealing with the spacing and bunding of tanks —to comply with a request from the Ministry of Fuel and Power for guidance. This draft indicated minimum requirements.

Publications Committee reported that "Annual Reviews" for 1947 should be published before the end of the year, and that progress was being made with the "Memorandum of Association and By-Laws."

Public Relations Committee, through Mr J. S. Parker reported progress on the question of the supply of demonstration models to teaching institutes, thanking Mr R. B. Southall for his work in approaching the Council of British Manufacturers of Petroleum Equipment and obtaining a favourable response. Mr Southall urged, and it was agreed, that an early meeting should be arranged between interested parties.

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Kelloggram No. 3 (1950), issued by M. W. Kellogg Co., Jersey City, New York, gives details of the modernization programme completed this year at the British American Oil Company's refinery in Montreal.

AROUND THE BRANCHES

FAWLEY, LONDON, NORTHERN, SCOTTISH, SOUTH WALES, STANLOW, TRINIDAD

London Branch

On May 23, a considerable audience was present, with the Branch chairman, N. E. F. Hitchcock, presiding, to hear the last paper of the London Branch 1949-50 session—"Alloyed Oils," prepared by R. D. Streeton, vice-chairman of the Branch, and A. C. Mauchan, both of the Anglo-American Oil Company Limited; the paper was read by the former.

After a brief examination of the earliest forms of additive—some of them remarkable compounds including seaweed jelly and even emery powder—which were mostly used with animal and vegetable lubricants from the middle of the nineteenth century onwards, the paper traced the effect of increasing mechanical demands, particularly in the I.C. engine, in stimulating the development of new additives to overcome limitations in the conventionally-refined petroleum lubricant and in some cases to impart qualities which could not be found in the original product. The number of patent applications filed was taken as a good indication of the rate of activity in this field, and the analysis was well illustrated by some slides of graphs showing patent applications for the various types of additive, year by year, in the U.S.A. and Great Britain separately.

A survey of the history of the development of several specific types of additive—oiliness additives, V.I. improvers, oxidation inhibitors and the like—showed clearly the influence of the many factors which have affected developments, especially since the 1920's; this led on to an examination of the technical and economic advantages to the refiner conferred by a greater freedom of choice of crude and the reduced amount of specialized refining needed.

The dramatic growth of the additive-manufacturing industry was linked with the growth and potentialities of the petroleum chemical industry, from which the authors rounded off their paper by a stimulating speculation on synthetic "tailor-made" lubricants.

This interesting paper provoked an active discussion, at the end of which, Mr Jukes proposed a vote of thanks which was carried with acclamation.

Visit to Woodstock Farm

Forty members of the London Branch, wives, and friends arrived at Woodstock Farm, near Sittingbourne, Kent, one of the experimental farms run by the Shell Group, on the morning of Saturday, June 21, to take part in the London Branch summer visit.

The party was formally welcomed by Dr J. E. Hardy, who is in charge of Shell agricultural research in the United Kingdom. He explained that Woodstock Farm was bought in 1945 and had been gradually converted into a tool for research into the contribution which the petroleum industry can make towards combating the many forms of weeds, plant pests and diseases which cause so much trouble and loss to farmer and fruit-grower. It worked in close collaboration with the other Shell farms in Holland and California, and liaison was also maintained with Government research stations. The main lines of attack were petroleum-derived chemicals or other chemicals, often using some petroleum product as a carrier, which warranted research into associated agricultural and horticultural problems, including the design of new apparatus and improvement of existing design for applying the chemicals. The farm consisted of some 250 acres, with normal farm buildings, an office, conference rooms, the all-important laboratories, and cottages for the farm labourers.

The tour started with a visit to the laboratories where the effect of various preparations on weeds, insects and fungi is first tried out under controlled conditions. Those preparations which show promise are then put out to field trials, first on a small scale and then, if still successful, on full scale. The results of the field trials are evaluated in the laboratories and compared with the original "test-tube" work. Much trouble had been taken to lay out the laboratory exhibits in an interesting way and the various specialists explained their work with admirable clarity. There were demonstrations of many ingenious pieces of apparatus, including a set-up for mass photography of pots of treated weeds in stages varying from hale-and-hearty, through moribund, to satisfactorily dead. After the laboratories, a number of machines were convincingly demonstrated which had been developed or adapted at Woodstock for applying the various weed-killers, insecticides, fungicides and soil fumigants in properly-regulated dosages and in the right places.

As guests of the "Shell" Refining and Marketing Company, Limited, who operate Woodstock Farm, the party then had an excellent lunch, at the end of which the chairman of the London Branch, N. E. F. Hitchcock, thanked the company, Dr Hardy, and the manager and staff of the farm who had given up their Saturday to make possible the visit which everyone was so thoroughly enjoying. Dr Hardy responded with a brief speech.

After lunch the party divided, to walk round the farm, in opposite directions, and see the outside work in progress. A short lane, the weeds on the verges of which had just been very thoroughly sprayed and killed, led to a fine old walled garden, inside which was a glass-house in which the atmospheric conditions of the growing season can be reproduced at will all the year round. In the glass-house was a form of miniature railway, on which an ingenious machine ran briskly past rows of pots full of weeds, spraying them with an exactly-measured quantity of any desired weed-killer. Outside, there were all kinds of vegetables and fruit-bushes and trees on which the small-scale field trials are carried out.

From there, a 7½-acre hop garden led to the small-scale cereal trial area and finally to the full-scale field trials of fruit-trees and cereal crops, which are grown in entirely normal conditions. The chemical preparations are applied by methods available to the ordinary efficient farmer, and then, with a careful check on yields, reliable information of practical performance is obtained, to be confirmed by subsequent country-wide trials. At each point the party was met by the specialist in charge of the particular activity, who made all clear even to the most unscientific layman; so smooth was the entire organization that the demonstrator was ready and waiting at each section, with no air of having been conjured hastily from a car or forced to run from one party to the other.

After a fascinating tour and good deal of healthy exercise, on a day when a certain amount of cloud tempered the fierceness of the midsummer sun, our most genial and friendly hosts saw the party off with some light refreshment. Most went on to a roadhouse, on the way back to London, where an informal dinner had been arranged. If the day in the country had rather reduced the enthusiasm for dancing after dinner, nevertheless the evening was an agreeable finale to a very interesting and enjoyable day.

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Sigmund at Stanlow is the title of an illustrated booklet describing the part played by Sigmund Pumps Ltd in the new Shell petrochemical plant at Stanlow. Copies on request from Sigmund Pumps Ltd, Terminal House, 52 Grosvenor Gardens, London, S.W.1.

PREPARATION OF SCIENTIFIC MSS

In 1948 the Royal Society held a scientific information conference at which concern was expressed about the quality of scientific papers presented for publication. A committee was set up, under the chairmanship of Professor G. L. Brown, C.B.E., F.R.S. to prepare a pamphlet that would serve as a general guide to authors, particularly those who were writing for publication for the first time.

The resulting pamphlet ("General Notes on the Preparation of Scientific Papers," Cambridge University Press, 2s 6d) should prove of considerable value. It is emphasized that the pamphlet "should be read in conjunction with any instructions issued by the journal in which the author hopes to publish," and the would-be author is throughout advised to "study recent issues of the journal." None the less the principles laid down in the pamphlet for the composition of the paper, as well as its setting out in typescript, are basic and sound, as are the instructions for the drawing and captioning of diagrams. The notes on references are extremely useful and clear and, under the heading "Nomenclature, symbols and abbreviations" are given sources of information on the nomenclature of various branches of science.

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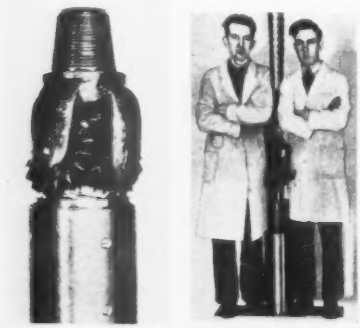
FISHING MAGNET

A range of fishing magnets, the largest with a housing diameter of 10½ inches and capable of lifting more than a ton, is being made by the Kingston Instrument Co. to a design sponsored by Shell engineers.

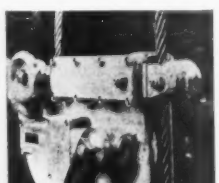
These tools have proved their usefulness in the Indonesian fields, where the Japanese, before evacuating, had filled deep wells with scrap metal, lengths of rotary chain, old valves, and other metal bits not easily recoverable by the normal fishing tools available. The use of the magnets has now spread from Indonesia to the Middle East.

The magnet is run into the hole either on a wire line or on the end of a drill pipe, the former method being preferred. The latter has occasionally to be resorted to when the end of the fish has to be washed clear so as to allow the magnet to make contact.

The Kingston Instrument Co. has also developed an aluminium alloy depthometer, which is extremely light and easily handled by one man. In use, the wire line run into the well for measuring depths is held against a knurled measuring wheel by means of two spring-loaded rollers. A direct reading of depth is given in feet, or through the introduction of a small gear box, in metres.



Fishing magnet: On the left a 10½-inch magnet holds an 8-inch 65-lb rock bit. On the right a 7¼-inch magnet supports the weight of two men standing on a metal plate.



Aluminium alloy depthometer.

PERSONAL NOTES

R. A. Carder (left), chairman and managing director of the Anglo - American Oil Co. Ltd. has completed thirty years' service with the Esso organization, and **Leonard Sinclair**, managing director, is seen presenting him with the thirty years' service button, which takes the form of a diamond studded five-pointed star.

Mr Carder joined the company in 1920. Ten years later he was appointed company Secretary, and in 1933 was elected to the Board.

Captain E. C. Eric Smith, M.C., has been appointed a director of Anglo-Iranian Oil Co. **F. W. Lund** has resigned from the Board.

W. G. Weston, C.M.G., has been appointed general manager of Anglo-Saxon Petroleum Co's Marine Department.

R. J. Pinder, M.Inst. Pet., has been appointed deputy general sales manager of the Anglo-American Oil Co. His former appointment, that of assistant general sales manager, is now being held by **G. W. Powell.**

O. F. Thompson, O.B.E., F.Inst. Pet., has been appointed to the Council of the Institute to fill a casual vacancy.

Selby T. Robson, who was one of the founders and first Chairman of the Council of British Manufacturers of Petroleum Equipment, has been appointed a director of Head, Wrightson & Co. Ltd.

Joseph Coates, F.Inst. Pet., senior geologist of the Burmah Oil Company, left India for the U.K. in June preparatory to retirement. He has been with the B.O.C. for more than 25 years and in recent years has been engaged, largely in a supervisory capacity, on oil exploration in India and Burma.

He joined the B.O.C.'s geological staff in 1923 after qualifying at the Royal School of Mines and the early part of his career was spent in geological mapping and on oilfield development problems in widely separated areas of the sub-continent and in Burma.

From 1929 to 1938 he was occupied almost entirely on oilfield development in Burma and in 1935, was sent on a visit to the U.S.A., to study gas injection and controlled directional drilling.

Mr Coates is a member or fellow of various learned societies, including the National Institute of Sciences of India, the Geological Society (London), the Institute of Petroleum, and is on the Council of the Mining, Geological and Metallurgical Institute of India.

R. J. E. Dodds, joint general manager of Anglo-Saxon Petroleum Co.'s Marine Department, recently retired, after nearly 30 years' service with the Royal Dutch/Shell group of companies.

Starting his career in 1908 as an apprentice aboard the tanker *Potomac*, Mr Dodds obtained his mate's certificate in 1913. During the first world war he served in submarines.

Mr Dodds joined the Mexican Eagle Oil Company as assistant wharf master of El Aguila's terminal, remaining abroad until 1939, when he returned home to become manager of the Eagle Oil and Shipping Co.'s Marine Department. In addition, in 1942, he became manager of the Shipping Division of Anglo-Saxon's Marine Department. During the last war Mr Dodds was a member of the Tanker Consultative Committee of the Ministry of War Transport, the Petroleum Board, and the Tanker Tonnage Committee. At the request of the U.K. Government, he made a number of wartime surveys of oil loading terminals,—in the Caribbean area, the United States and later at Le Havre, Rouen, Boulogne and Ostend.

WORLD PETROLEUM CONGRESS

It is announced that the following have accepted the invitation to serve on the Committee of Honour of the Third World Petroleum Congress, to be held in Holland from May 28 to June 6, 1951, in addition to those mentioned in our issue of June:—

The Commissioner for the Queen of the Netherlands in the Province of South Holland.
The Burgomaster of the Hague.
The President of the Koninklyk Instituut van Ingenieurs.
H. Bloemgarten, managing director, N. V. de Bataafsche Petroleum Mij.
Jonkheer H. A. van Karnebeek, managing director, N. V. Standard-Vacuum Petroleum Mij.
B. Klaare, managing director, N. V. Standard Amerikaansche Petroleum Cie.
J. A. Triska, managing director, Caltex Petroleum Mij (Nederland) N.V.

U.S. National Committee

A total of twenty-three national committees have now been set up in connexion with the congress, and the constitution of the U.S. National Committee is given as:—

E. Bartholomew (*Ethyl Corpn.*).
J. E. Brantly (*Drilling & Exploration Co. Inc.*).
F. S. Clulow (*Shell Oil Co. Inc.*).
P. D. Foote (*Gulf Research & Development Co.*).
A. P. Frame (*Cities Service Research & Development Co.*).
J. R. Keith (*Caltex Oil Co. Ltd.*).
G. C. Kirkbride (*American Institute of Chemical Engineers*).
E. V. Murphree (*Standard Oil Development Co.*).
L. L. Nettleton (*Gravity Meter Exploration Co. Ltd.*).
M. E. Spaght (*Shell Development Co. Ltd.*).

Papers

It is anticipated that approximately 200 papers will be presented for discussion at the Congress or for publication in the proceedings. The quota for Great Britain is 50 and arrangements are well in hand for their preparation.

Travel Arrangements

Messrs Thomas Cook & Sons Ltd. have been appointed travel agents in connexion with bookings for those attending the Congress from Great Britain. Enquiries as to travel facilities, currency problems, etc. can be made at any of their branches.

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WORKS SAFETY CONFERENCE

A conference on safety in chemical works, organized by the Royal Society for the Prevention of Accidents on behalf of the Association of British Chemical Manufacturers is being held in Scarborough from September 29 until October 1.

The opening address (Friday evening) will be given by Prof. D. M. Newitt, and followed by a paper on "Safety in the services department" by J. Eyers (*Vulcan Boiler & General Insurance Co.*).

On Saturday morning there will be papers dealing with fire hazards in the petroleum industry by E. E. Chanter ("*Shell*" *Refining & Marketing Co. Ltd.*) in the manufacture of solvents by J. Howlett (*The Distillers Co. Ltd.*), and on "Investigations of the causes of a fire," by Dr. J. B. Firth (*North Western Forensic Science Laboratory*).

Saturday evening is devoted to a Quiz, with H. R. Payne (*I.C.I. Ltd.*) as Quiz-Master, and Dr A. J. Amor (*Association of Industrial Medical Offices*), I. E. Baggs (*National Smelting Co. Ltd.*) G. Brearley (*Brotherton & Co. Ltd.*) and K. W. Rattenbury (*British Industrial Solvents Ltd.*) as the team.

At the final session on Sunday morning, W. E. Chipperfield (*Babcock & Wilcox Ltd.*) will discuss the B.S. Code 1500 for fusion-welded pressure vessels for the viewpoint of the manufacturer, and J. W. Stranson ("*Shell*" *Refining & Marketing Co. Ltd.*) will deal with the user's point of view.

Application forms from the Society at 131 Sloane Street, London, S.W.1.

A.S.T.M. & I.P. CO-OPERATION IN INTERNATIONAL STANDARDIZATION*

By H. HYAMS (Fellow)

Introduction

There is no denying that the first reaction of the normal human being towards "standardization" is one of scepticism. It is only when his attention is drawn to the advantages of interchangeability, low cost, safety, universality, and so forth that he gradually becomes aware of the extent to which he has personally benefited through standardization. The main objective of standardizing bodies is the establishment of standards for quality and of fitness for the purposes intended, coupled with sound performance. The many thousands of standard specifications produced by national standardizing authorities testify to the extent and value of this work. Upheavals such as world-wars show in how many ways there has been too little standardization and sometimes too late. The Allied military authorities in the last war could speak eloquently on this subject.

Since this paper is concerned with International Standardization it is worth while devoting a little time to a study of the machinery which exists for this purpose and seeing where the American Society for Testing Materials and the Institute of Petroleum fit into the framework.

The International Organization for Standardization (I.S.O.) was formed in October 1945, replacing the pre-war International Standards Association. The primary object of this international organization is associated with the provision of facilities through which the national standardizing bodies of the world can promote the maximum co-ordination and unification of national standards. Membership is open to the national standardizing bodies of all countries, and these national bodies are the ultimate authority of I.S.O.

Any member body may recommend a standards project for consideration provided that the recommendation is accompanied by a statement setting out the scope of the work prepared and the reasons which justify action being taken. It must be emphasized, however, that I.S.O. acts as a clearing house and does not press any proposed standards on any national standardizing body. In fact, no international standards are set up if any member body dissents.

Of the twenty-seven countries participating in I.S.O., the U.S.A. is represented by the American Standards Association (A.S.A.) and the U.K. by the British Standards Institution (B.S.I.).

I.S.O. entrusts "secretariats" for standardization projects to various countries through their national standards associations, which in turn execute the secretariat through their appropriate industry committees. A good example demonstrating the operational procedure is this. I.S.O. listed as one of its projects requiring attention, Petroleum Products and Lubricants. The secretariat for this project, No. 28, was handed to U.S.A. This meant that the American Standards Association accepted responsibility for setting up the secretariat and for preparing a programme covering standardization in the

* Abridged from "A.S.T.M./I.P. Co-operation in international standardization, with particular reference to all measurement," read before the Stanlow Branch of the Institute on November 16, 1949.

field of petroleum products and lubricants. A.S.A. have in turn enlisted the support of their own American affiliated organizations such as A.P.I. and A.S.T.M. in acting as a collecting and clearing house for ideas submitted by the various national industry committees connected with I.S.O.

A few words may be added about the national standardizing machinery operating in the United States and in Great Britain.

The A.S.A. and the A.S.T.M.

The American Standards Association (A.S.A.) was organized in 1918 and is a federation of 102 national technical and trade organizations maintained by industry to promote the development and use of standards. The three organizations in the U.S.A. best known to the petroleum industry are the American Society for Testing Materials (A.S.T.M.), the American Petroleum Institute (A.P.I.), and the United States National Bureau of Standards (N.B.S.). When a standard is approved by A.S.A. it implies agreement between the manufacturer, seller, and user that the article is of good quality and performance, is suitable for its purpose, and possesses a considerable degree of interchangeability. American standards are used throughout industry and by municipal, state, and federal governments. Manufacturers use them to facilitate production operations, to lower production costs, to eliminate controversies between buyer and seller, and to raise the level of industry by eliminating misrepresentation. They are also used by consumers as a yardstick to measure the merit of the goods they buy, and by government agencies both in their capacity as buyers and as protectors of the public interest.

As already indicated, the secretariat for I.S.O. Project 28 on Petroleum Products and Lubricants is held by A.S.A. who have delegated the work to the A.S.T.M. and the A.P.I.

The specific purpose of the A.S.T.M., which was organized in 1898, is "the promotion of knowledge of the materials of engineering and the standardization of specifications and the methods of testing." Its objectives are achieved largely through the activities of over 700 technical committees which are responsible for the development of standard specifications and tests and seeing that these are kept up to date. Membership has grown from a mere 70 in 1898 to nearly 6500 in 1949. The great increase in the number of Standards issued is indicated by the fact that the 1936 two-volume Book of A.S.T.M. Standards was a work containing a total of 513 Standards, whereas the 1948 issue consists of five volumes containing a total of 1510 Standards. The 1949 edition comprises six volumes.

Insofar as the petroleum industry is concerned the A.S.T.M. Committee best known to those in Britain is D2 which deals with petroleum products and lubricants.

The B.S.I. and the I.P.

The organization, functions and constitution of the British Standards Institution may be regarded as being closely parallel to those of the A.S.A. The B.S.I. has a General Council under which there are building, chemical, engineering, and textile divisional councils. Under these divisional councils there are the various industry committees, consisting of 285 technical committees and 365 sub-committees. So far as we are concerned, there is a Petroleum Industry Standards Committee and a Petroleum Equipment Standards Committee. The first of these deals essentially with specifications for petroleum products, the second with standards for plant and equipment used in the petroleum industry. The importance of the B.S.I. in international standardization is revealed by the steadily increasing tendency of the standards bodies of South American countries (in particular the recently-

formed Argentine Standards Association) to adopt British standard specifications as their own.

The history, organization, and functions of the Institute of Petroleum (I.P.) have been set out in a booklet published by the Institute, and are, no doubt, so well known that it is unnecessary to go into detail, except to say that the standardization work of the Institute is regarded by the Council as an intrinsic and important part of the Institute's work. The Institute's book of petroleum standard methods of test is known the world over.

The standardization work of the Institute of Petroleum is carried out by the Standardization Committee and the Engineering Committee. The Standardization Committee is primarily concerned with methods for testing crude petroleum and its products. It consists of representatives of both the petroleum industry and the consumers, the latter including a number of government departments. The work of the committee is divided among a number of sub-committees, each of which deals with a particular product or range of products, or some special subject such as measurement and sampling, or nomenclature. The sub-committees in turn have panels and working groups engaged in detailed experimental work which is usually carried out in the laboratories of the petroleum companies, the engine manufacturers, and government departments.

The Engineering Committee functions in a manner similar to that of the Standardization Committee. It is only in very recent years that it has undertaken a programme of standardization work which covers, principally, engineering equipment used in producing, refining, distributing, and storing petroleum. In 1946, the Committee completed an electrical code for the petroleum industry and this has been published by the Institute; good progress has been made in the preparation of other codes of safe practice.

The committee organization of both the I.P. and the A.S.T.M. is very well adapted to develop standard test methods and in the case of the A.S.T.M. also standard specifications. On the main technical and administrative committees, and the hundreds of sections and panels of both bodies, are experts who are outstanding in their technical fields and who are fully acquainted with the scope and limitations of the manufacturing processes, the consumer requirements, and the various uses to which the materials and products are put.

Briefly, so far as the petroleum industry is concerned, the set-up for standardization in the U.S.A. and in the U.K. may be summarized as:—

(*a*) *In the U.S.A., work for the A.S.A. is carried out by the A.P.I. on petroleum equipment and by the A.S.T.M. on specifications and tests for petroleum products.*

(*b*) *In Great Britain, the B.S.I. itself prepares specifications for petroleum products through its Petroleum Industry Standards Committee, and standards for petroleum equipment through its Petroleum Equipment Standards Committee. The Institute of Petroleum produces standard methods of petroleum testing which are accepted by B.S.I.*

Co-operation Between A.S.T.M. and I.P.

In the field of their respective standardization work there has undoubtedly been a large measure of co-operation between A.S.T.M. and I.P. for many years. But it may well be asked "Is there sufficient co-operation between the two bodies?" and "How far are the two bodies falling short of what they might achieve?". These two questions may be dealt with by examining briefly the present state of the co-operative work on standardization between the A.S.T.M. and the I.P.

It is obvious that if two English-speaking bodies are spending a con-

siderable amount of time and money, and are doing a considerable amount of investigatory work in trying to arrive at a common goal, then the results of their efforts should be as closely as possible identical. As an illustration, if the A.S.T.M. make recommendations for a standard method of test for a petroleum product (for example, the test for oxidation stability of motor fuel), there would seem no reason at all why the I.P. recommendations for the same standard should not be identical. If there are differences of opinion, then every possible endeavour should be made to reach a compromise between the two bodies, resulting in the production of a joint method which might be an improvement on both original methods.

Both the I.P. Standardization Committee and A.S.T.M. Committee D2 issue yearly a volume of standard methods for testing petroleum and its products. Although they have much in common, they are by no means identical.

Comparison of these two books reveals that the two bodies are not unaware of each others publications and activities. The ready acceptance by I.P. of engine test methods, sponsored by A.S.T.M., for the evaluation of aviation and motor fuels, and the adoption by A.S.T.M. of the I.P. Ramsbottom carbon residue test, are evidence of a certain measure of collaboration. However, a few instances, taken at random from the two books of methods, illustrate the type of modification which could have been prevented had there been intimate co-operation between the two committees from the outset of the drafting of the method.

Ramsbottom Carbon Residue

The I.P. method (I.P. 14) was first published in 1929 and was adopted by A.S.T.M. (D.524) as a tentative method in 1939. The A.S.T.M. introduced into their method a different type of coking bulb. Whereas the I.P. method recommends a resistant glass bulb, the A.S.T.M. recommends a stainless steel crucible-type bulb, fitted with a close-fitting capillary cap of similar material. By this arrangement the bulbs may be easily and quickly cleaned for repeated use. The glass bulbs are difficult to clean, and are usually thrown away after being once used, an expensive business when the cost of each bulb is considered. Although this drawback is not associated with the stainless steel bulb the use of these is not entirely free from criticism. Instances of distortion of the metal cap after the test have been observed, and this has meant the rejection of expensive apparatus. Furthermore, the weight of the metal bulb is excessive when related to the very small weight of the carbon residue obtained in the test.

Distillation of Products Boiling Below 370° C

The footnotes to the I.P. method (I.P. 123) indicate that the A.S.T.M. method D. 216 (natural gasoline), D. 86 (gasoline), and D. 158 (gas oil) have been modified. The modifications included are mainly in regard to apparatus, that is, the use of B.S. flasks and graduated receivers has been specified. The Engler flask laid down by A.S.T.M. is for all practical purposes identical with the B.S. flask specified by I.P. In the case of the 100-ml distillate receivers, the I.P. method allows the use of the B.S. Crow type, whilst A.S.T.M. receivers are of uniform diameter.

Loss on Heating of Bitumen and Flux Oil

In this oven-heating method, the A.S.T.M. (D. 6) procedure lays down that samples must be water-free. Any results on samples which foam are rejected. The I.P. procedure (I.P. 45) allows the testing of sampies containing water, provided that excessive foaming does not occur, and corrections for water are made.

Oxidation Stability of Motor Fuel

In this method a sample of gasoline enclosed in a bomb is heated in contact with oxygen under pressure, and from the time taken for the pressure in the bomb to fall a known amount, the oxidation stability, reported as the "induction period at 212° F" is calculated. The A.S.T.M. (D. 525) and I.P. (I.P. 40) definitions of the termination of this period of time are not however the same.

The differences in methods and procedures which have been briefly outlined, are only comparatively minor in degree. In none of these cases does the difference imply a fundamental change to the method as a whole.

The practice of the standardizing body, where changes are revolutionary, is to publish the new procedure as an alternative procedure, or to issue it as a new method, giving it a new method number. For example, in the determination of viscosities, conventional viscosities as determined by the Redwood instrument are described under I.P. 70, whilst viscosities determined in absolute units are given under I.P. 71. Similarly the A.S.T.M. procedure for evaluating the viscosity of an oil by the conventional Saybolt instrument is given under D. 82, and the procedure for absolute viscosities under D. 445.

Viscosity (kinematic) in Absolute Units

The methods for determination of absolute viscosity published by the two Societies afford another example of where they have apparently agreed to differ. The heading I.P. 71 indicates that A.S.T.M. D. 445 has been modified. One of the major modifications is permission to use the B.S.I. U-tube viscometer as an alternative to other types of capillary tube viscometers. This is an example where standardization between the I.P. and A.S.T.M. will take longer to achieve. As the U-tube viscometer is favoured by the B.S.I., the three standardizing bodies must first agree before the object is attained.

The I.P. "Standard Methods for Testing Petroleum and Its Products" for 1948 contains 115 methods, of which acknowledgment is made to A.S.T.M. for 35 methods, that is 30 per cent of the total number. 83 per cent of these adopted methods, i.e. 29 out of the 35, have undergone modification on the whole to a minor degree. It is difficult to assess to what extent these changes, however small, may lead to suspicion of each others results, but such possibilities cannot be lightly dismissed. The knowledge that a particular I.P. method is a modification of its A.S.T.M. counterpart can, and does, incline operators to introduce other improvisations, the significance of which may not be fully appreciated. Where private or strictly internal arrangements hold good such activities need not be condemned; they may, under adverse circumstances, be necessary. The standard methods as published by I.P. and A.S.T.M. are however intended to be used as reference methods, such as between seller and buyer, and frequently on an international footing. In these circumstances no deviation from the standard procedure for a particular test method should be permissible. The availability of recommended apparatus, more than any other factor, should control the extent of any modifications: differences in procedure should be ironed out before publication.

All this can only come about by an interchange of ideas, suggestions, and tentative recommendations between the committees of I.P. and A.S.T.M. responsible for the drafting and production of test methods.

PROGRESS TOWARDS UNIFICATION

Progress towards unification has been and is being made. The I.P. book of standard methods now quotes the corresponding A.S.T.M. method usually as "modified"; sadly, there are only very few examples of recognition of I.P. methods in the A.S.T.M. book. How-

ever, there is increasing evidence of the realization on the two sides of the Atlantic of the need for the closest conformity in published Anglo-American standardized methods and procedures for petroleum products.

In June 1949, there was a meeting in London of the Chairmen of I.P. Standardization Sub-Committees on the one hand, and A.S.T.M. representatives on the other, at which the unification of test methods was discussed. The need for this unification was agreed, as was the fact that in devising new methods there is a considerable risk that A.S.T.M. and I.P. committees may wastefully cover the same ground in their experimental work. The question of the mechanism by which unification of methods and avoidance of duplication could be achieved was also discussed; one means of accomplishing this will be the future direct correspondence between chairmen of corresponding sub-committees, etc.

It is realized that it is most desirable to avoid making alterations and amendments to methods without mutual explanation of the need for these.

There are cases where oil companies whose spheres of activity cover various parts of the world, include both A.S.T.M. and I.P. methods in their own standard methods, and who need metric versions of these methods. These companies, and the international petroleum trade generally, would greatly benefit if A.S.T.M. and I.P. could agree on a joint method and then translate this joint method into metric units. Metric versions of existing standard methods are needed in Europe as well as, for example, in Mexico, a country into which Fahrenheit thermometers may not be imported, and where they may not be used. This affects such tests as flash and pour points.

There is, furthermore, the need for translation of agreed A.S.T.M. and I.P. methods into foreign languages. The translation work would be considerable but the absence of say French and Spanish editions of these methods leads either to faulty local translations or worse still the production of alternative methods for the same test by some local authority. There were far too many varieties of petroleum test methods in Europe before 1939 and it would be a most retrograde step if new local methods again began to appear because the British and the Americans could not produce sound, agreed test methods easily applied in other countries.

To summarize, what is necessary to obtain closer co-operation between the I.P. Standardization Committee and A.S.T.M. Committee D2:—

(1) *I.P. equivalents should be quoted in A.S.T.M. methods as a first step towards the ultimate goal of a joint book of standard methods.*

(2) *Where new methods are under development, or revisions of existing methods are contemplated, the A.S.T.M. and I.P. chairmen concerned should keep in direct contact during development work, and with the proposals for further work. Differences should be resolved at all stages of production and revision, and if necessary a mutually agreed compromise version should be adopted for publication.*

(3) *Metric equivalents of current methods should be prepared for metric countries, since many of these use either A.S.T.M. or I.P. Methods. The writer would prefer to see A.S.T.M/I.P. publish metric versions of agreed methods under their joint imprint, and so far as it is practical to have such metric versions available in foreign languages.*

(4) *Agreed A.S.T.M/I.P. methods should be furthered for international standardization through I.S.O.*

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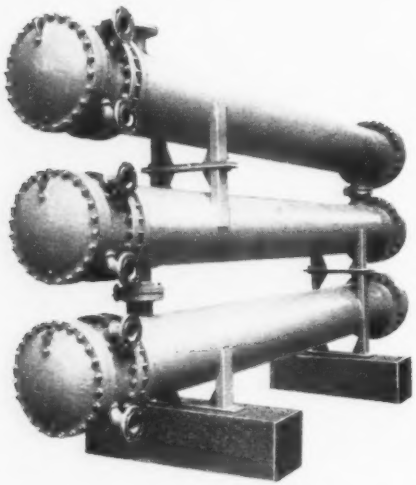

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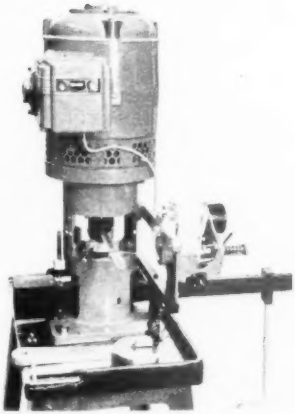

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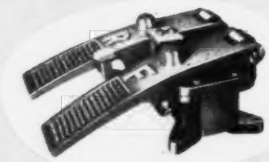

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